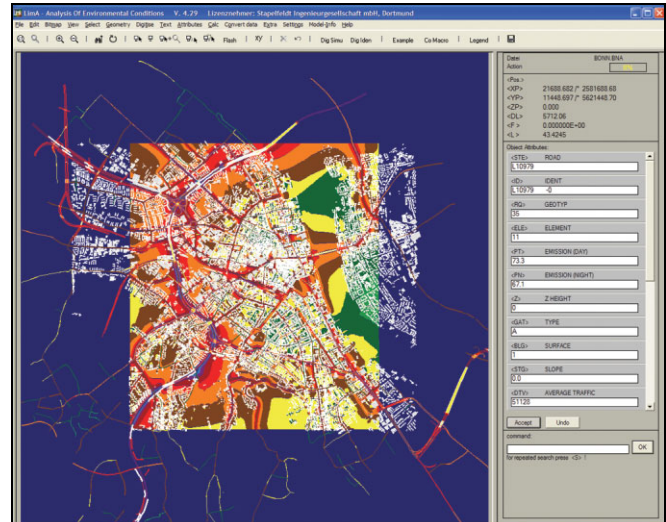


PRODUCT DATA

Lima Environmental Noise Calculation and Mapping Software Version 5.0 — Types 7812 A/B/C

Lima™ is the most powerful noise calculation system available. It includes advanced automated data manipulation, geometric handling and allows you to efficiently perform large, accurate noise calculations from existing data sets, without the need to use other software, such as GIS (Geographical Information Systems) and AutoCAD®. With fast algorithms and a huge capacity, Lima can make rapid, yet accurate, calculations. It is highly flexible, allowing in-depth analyses, and its openness eases integration with external data sets, calculation components and software.



USES AND FEATURES

USES

- Environmental noise mapping, management and impact assessment
- Fulfilment of European Commission directives such as Environmental Noise Directive (2002/49/EC) in accordance with Guidelines on Revised Interim Computation Methods (2003/613/EC) and the European Commission's Assessment of Exposure to Noise Working Group's Good Practice Guide, and fulfilment of the IPPC Directive (96/61/EEC)
- Integration in environmental management, traffic management and Geographical Information Systems (GIS) as noise-calculation core
- Research – defining new object types, attributes and attribute relations in user defined DLL files (e.g., creating emission data with respect to parameters not defined in the regulations)

FEATURES

- A range of software options from small-scale impact assessments to mapping of agglomerations

- Calculation of environmental noise in accordance with a wide range of leading national and international standards and methods
- Data import in many formats, e.g., GIS, AutoCAD (DXF), and traffic-flow data (e.g., Microsoft® Access)
- Advanced combination and optimisation of data from several sources to create 3D topographical models
- A range of modelling tools to accurately and efficiently deal with complex acoustic problems such as cantilever roofs, bridges, screens on bridges, and roads over undulating terrain
- Pre- and user-defined macros for automation of modelling tasks
- State-of-the-art calculation speeds through efficient implementation of algorithms, advanced source-selection and optimisation of calculation tolerances, allowing fast calculation without grid interpolation techniques
- Vertical and horizontal grid calculation, including noise levels across a façade
- Built-in annoyance analysis tools

New Features in Version 5.0

Compared to Lima version 4.3, version 5.0 has the following new features:

For All Configurations

- Calculation of the overall uncertainty of results, based on average of uncertainties of input parameters
- New methods: Harmonoise, Hungarian Standards UT2.1-302 (road), MSZ 2904 (rail), MSZ 15036 (Outdoor Noise Propagation), DAL 32
- Compliance with Nordtest Method “Framework for the Verification of Environmental Noise Calculation Software” ACOU 107 (2001)
- Compliance with draft German Standard DIN 45687, concerning quality criteria for noise calculation software
- Interactive 3D tool
- Import of Type 2250 Hand-held Analyzer data

For Lima Plus (7812 B) and Lima Advanced (7812 C)

- Soundscaping: Audio-visual presentation of noise levels at selected receiver points
- Increased Calculation Capacity
- All Lima Advanced statistical functions now also available in Lima Plus allowing, for example, calculation of noise exposure statistics in tables (e.g., population, areas)

For Lima Advanced (7812 C) Only

- Now includes ECAC Doc. 29
- Calculation Client License Pack BZ 5553 for increased calculation speed on a network

The Lima Concept

Lima is the most powerful noise calculation system available. It includes advanced automated data manipulation, geometric handling and allows you to efficiently perform large, accurate noise calculations from existing data sets, without the need to use other software, such as GIS and AutoCAD. With fast algorithms and a huge capacity, Lima can make rapid, yet accurate, calculations. It is highly flexible, allowing in-depth analyses, and its openness eases integration with external data sets, calculation components and software. This makes it ideal for universities, for local authorities without quality input data or for users requiring calculation software with built-in GIS and AutoCAD functionality.

The Lima server concept enables it to support multiple-processor systems and networks, allowing it to maximise its computational capacity. Several workstations in a network environment can be set up with different functionalities, therefore providing a powerful, cost-effective solution. For example, a remote server can be dedicated to the time-consuming task of calculating results, several workstations can model entry and data analysis, while a PC is dedicated to preparing reports. Additionally, several servers could simultaneously work in the background to sequentially queue and perform tasks whenever there is free capacity available on the network. This server concept eases the integration of third-party software modules into the Lima graphic user interface (GUI) and even allows the mixed usage of Windows[®] and UNIX[®]-based environments.

With Lima, 3D models can be built up from a range of data sources, thus greatly speeding up modelling time. Lima offers a large number of import and export facilities including the import and optimisation of geometrical data (e.g., from GIS and CAD). This import of geometry and data offers the advantage of reusing existing data and ensuring a standardised quality of input data for intermodal studies (e.g., for evaluating different pollutants and socio-demographic factors). However, as most geometrical data has not been created with acoustic modelling in mind, Lima ensures quality data via a number of powerful techniques including:

- Closing polygons to ensure correct modelling of, in particular, buildings
- Recognising and preventing multiple existence of objects
- Linking objects to prevent gaps in the model
- Smoothing polygons to reduce the number of vectors and speed up calculations

Complex acoustic problems, such as fly-over intersections, are dealt with accurately and efficiently through Lima's advanced modelling tools. Once a model is built, its market-leading calculation speed is augmented by optimal accuracy through automatically neglecting irrelevant sources that contribute insignificantly to noise levels at a particular position, based on user-defined accuracy demands.

The unique Lima command line, macro and configuration features, combined with the familiar menu-based user interface, make it one of the most powerful and flexible calculation software packages on the market.

Lima is high quality software under continuous development. So, naturally, Lima complies with state-of-the-art quality assurance methods, such as the Nordtest "Framework for the Verification of Environmental Noise Calculation Software" ACOU 107 (2001) Method and the draft German Standard DIN 45687 (2004) regarding quality criteria for noise calculation software.

Lima is part of Brüel & Kjær's environmental noise concept where measured and calculated data can be used to optimise a wide variety of environmental noise management tasks. For example:

- Determining L_W levels of several interacting sources, using the Reverse Engineering method
- Optimising L_W levels for industrial estates (fixing quotas)

- Determining and presenting residual noise levels and comparing these with specific calculated levels
- Presenting measured noise contours of residual noise levels for maps of emergence or overall level
- Determining relatively quiet façade levels for combining with other calculated façade levels

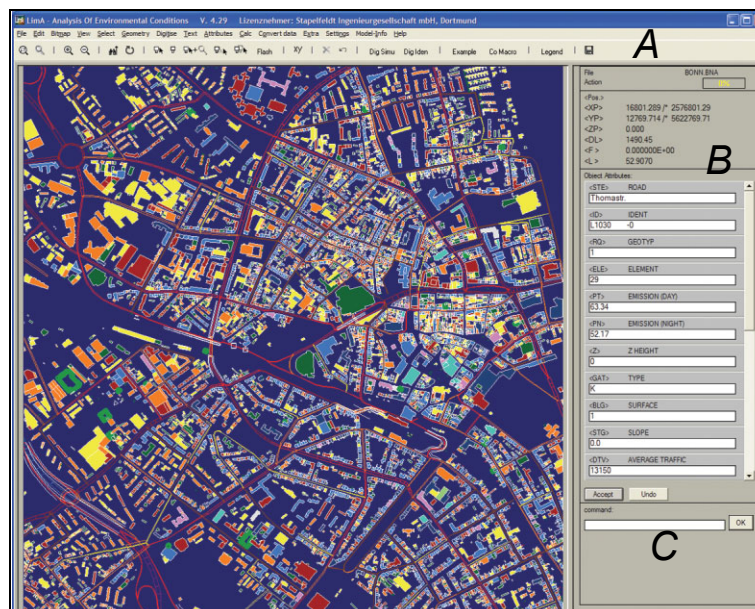
Modelling

Using Lima

Lima can be operated through its comprehensive menus or by powerful command lines (see Fig. 1) that give access to more than 100 dedicated and time-saving commands for coping with the majority of tasks involved in noise calculation and mapping. The toolbar is user-definable for including the tasks most frequently used by/or most useful to the user. All input is supported by context sensitive on-line Help and an input dialog is used to set up job files for a particular task (for example, plot layout and format) and then recorded for reuse.

Fig. 1

A typical Lima screen showing the menu and toolbar (A), status and attributes fields (B) and command line interface (C). Here, a road is selected and some of its attributes shown



Most functions can be summoned via a dialog box, however, the command line also offers access to these functions. It allows the use of variables, which can also be organised into macros. Model-handling speed can be greatly improved by nesting search loops. Powerful search commands that combine attribute and geometry relations are also available.

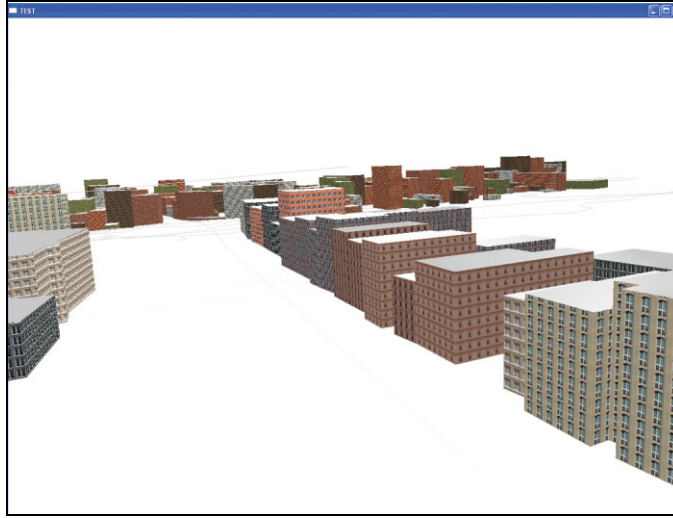
The on-line Help for object attributes can be edited by the user so that preferences and hints can be documented for future use.

Lima provides a wide range of simple and advanced geometry handling functions such as editing, selecting or clipping objects within a defined polygonal area, and creating parallel objects. Lima performs automatic geometry checks including the indication or correction of corrupt objects or multiple identical objects at the same position.

Information can be displayed on the model as user-defined symbols and text. This enables, for example, noise sources to be indicated by ID or noise-emission level. Each object type can be described by up to 200 attributes allowing, for example, 24-hourly traffic descriptors. Attributes can be automatically changed according to a user-defined filter or rule. Colour coding for each object type can be defined separately according to any of its attributes.

In addition, the **Lima Plus** and **Lima Advanced** packages (see page 12) offer 3D interactive visualisation in OpenGL[®] (see Fig. 2) or as hidden line vector graphics for quality assurance of models.

Fig. 2
OpenGL® views are available in Lima Plus Type 7812 B and Lima Advanced Type 7812 C

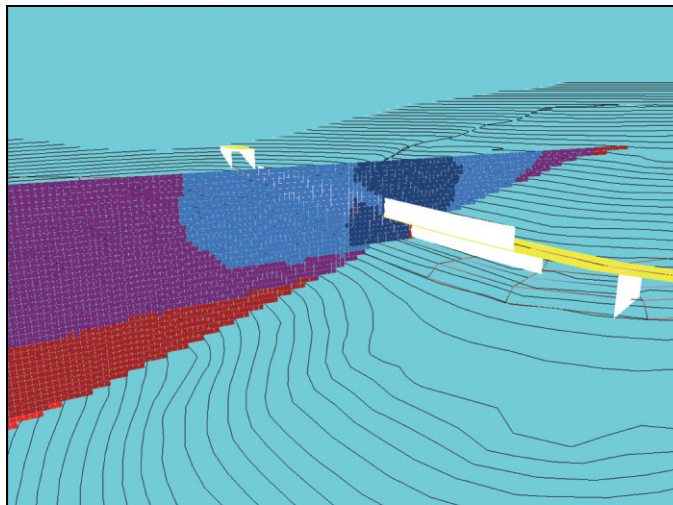


level parameters at receiver points. Several studies that estimate source sound power levels for various activities such as sports, car parks and lorry loading are included. Photographs of objects, e.g., sources, in bitmap files, as well as sound recordings, can be linked to them for easier recognition and better documentation.

Fig. 3
Example of object attributes

Index	ROAD	IDENT	GEOTYP	EMISSION (->P)	ZHEIGHT	TYPE	SURF	<D>V	WPHDAY
0002241	Am Alten Friedh...	L26021	-0 1	57.71	47.70	0	G 1	2150	189
0002242	Am Alten Friedh...	L26021	-0 1	57.71	47.70	0	G 1	2150	189
0002243	Am Alten Friedh...	L26021	-0 1	57.71	47.70	0	G 1	2150	189
0002244	Maximilianstr...	L25981	-0 1	61.42	52.29	0	G 1	8450	507
0002245	Maximilianstr...	L25981	-0 1	61.42	52.29	0	G 1	8450	507
0002246	Maximilianstr...	L25981	-0 1	61.42	52.29	0	G 1	8450	507
0002247	Hausdorffstr...	L26072	-0 9,1	62.85	53.92	0	G 1	10750	645
0002248	Hausdorffstr...	L26072	-0 9,1	62.85	53.92	0	G 1	10750	645
0002249	Bonner Talweg	L26113	-0 12,1	61.26	52.57	0	G 1	9000	540
0002250	Hausdorffstr...	L26116	-0 12,1	60.98	51.97	0	G 1	8450	507
0002251	Kölnstr.	L26197	-0 15,1	62.73	51.17	0	L 1	10450	627
0002252	Kölnstr.	L26214	-0 8	61.23	50.83	0	L 1	9650	579
0002253	Grauhendorfer...	L26226	-0 12,1	62.48	54.15	0	G 1	15100	906
0002254	Grauhendorfer...	L26226	-0 12,1	62.48	54.15	0	G 1	15100	906
0002255	Herseler Str.	L26250	-0 16,1	65.76	55.55	0	G 1	16672	1000,3
0002256	An der Joseph...	L26257	-0 8	64.89	55.70	0	G 1	12350	741
0002257	Grauhendorfer...	L100666	-0 12,1	63.45	55.19	0	G 1	17700	1062
0002258	Thener Str.	L100741	-0 8	63.25	54.23	0	K 1	8792	527,5
0002259	Reichstr.	L100823	-0 8	63.30	53.43	0	L 1	6950	417
0002260	Herseler Str.	L20684	-0 16,1	66.43	57.01	0	G 1	15250	915
0002261	Baumschulallee	L23683	-0 14,1	63.02	54.25	0	G 1	14250	855
0002262	Baumschulallee	L23683	-0 14,1	63.02	54.25	0	G 1	14250	855
0002263	Baumschulallee	L23683	-0 14,1	63.02	54.25	0	G 1	14250	855
0002264	Baumschulallee	L23683	-0 14,1	63.02	54.25	0	G 1	14250	855
0002265	Auf dem Hügel	L30256	-0 12,6	65.12	54.90	0	G 1	14384	863,0
0002266	Röttigener Str...	L30712	-0 1	59.52	49.83	0	K 1	10700	642
0002267	Röttigener Str...	L30712	-0 1	59.52	49.83	0	K 1	10700	642
0002268	Röttigener Str...	L30712	-0 1	59.52	49.83	0	K 1	10700	642
0002269	Röttigener Str...	L30712	-0 1	59.52	49.83	0	K 1	10700	642
0002270	Röttigener Str...	L30712	-0 1	59.52	49.83	0	K 1	10700	642
0002271	Ippendorfer All...	L31363	-0 1	66.63	51.04	0	K 1	8700	522

Fig. 4
Cross-sectional contour showing the effects of a screen on a bridge and reflections from the underside of the bridge



Building a Model

Models in Lima are built up from different elements. Sources can be defined as roads and railways, industry, aircraft, leisure and sports in accordance with several calculation methods. They can be point, line, area or vertical-area (façade) sources. Each source's emission can be time-variant, either by defining emissions for up to 24 periods within one calculation run, or defining extra attributes that document the duration of activities, impulse and tone corrections help to estimate rating-

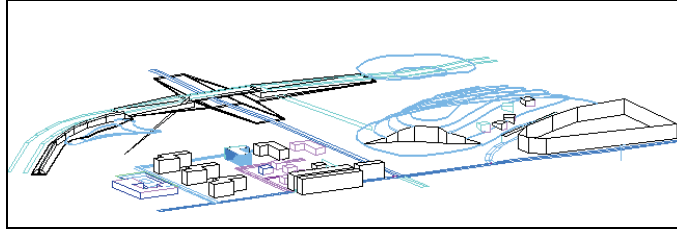
The model can consist of screens, buildings, embankments (with or without screens), bridges, cantilever roofs and areas with user-defined attenuation. These obstacles can be given different reflection factors on each side (for example, the underside of a roof can also be reflective) therefore allowing more accurate modelling of, for instance, bridges and petrol stations (see Fig. 4).

The user can define new object types, edit attribute types and input value pick-lists for existing objects, all with on-line help. This allows extremely flexible modelling and customisation.

A digital-terrain model represents the ground and is built up from single-point information, contour lines, ridges and cliffs. It is based on an interpolation scheme. Contour lines can be generated from point and ridge information and are treated as barriers to sound propagation.

Fig. 5

Complex geometry showing an embankment on uneven terrain with a screen on top, a barrier on a bridge, a quarry face and polygon buildings



Embankments with screens on top can be generated automatically from one base line onto uneven terrain (see Fig. 5), thus speeding up and improving the result of the modelling process. The heights of objects can be absolute or relative to terrain or

to buildings in it. Gradient information can also be used to define terrain structures.

Intelligent Interfaces with Other Software Ease Modelling

Data is entered into the model via a digitiser, a mouse and keyboard, or by importing it from several sources (see below). One or more bitmaps can be imported, scaled and correctly orientated as a background for building models. Alternatively, models can be built up from AutoCAD files through the DXF interface that also allows export of models back to AutoCAD or into GIS.

Objects can be linked to tabular data and to various types of databases such as DBF and Microsoft® Access to enable automatic creation of models, for example, the assignment of traffic-flow parameters to roads to determine their emissions. Databases of octave band data, reflection properties and directivity can be built up and interfaced to the model.

Fig. 6

An example showing the Lima concatenation function. The original AutoCAD building information, shown by white squares, represents the back walls of the real buildings. Similar lines represent the front walls and the building separators. Lima converts them to separate buildings (coloured polygons with white border)



Lima can import from a wide range of GIS and traffic packages such as ArcView®, ArcGIS™, Atlas GIS™, GeoMedia®, MOSS, SICAD® and SICAD® SQD. With the SHAPE (SHP) format data exchange, model data of any other common commercial environmental noise software can be calculated. The Lima Plus and Lima Advanced packages include data exchange in DXF and SHP format. A separate Lima Data Exchange Module including data interface in all available interface formats is also available.

Most geometrical data does not usually consider any acoustical aspects and the quality of imported geometry can vary greatly,

thus necessitating pre-processing. Lima offers a number of powerful pre-processing tools that greatly reduce pre-processing time and effort:

- All Lima packages include an automatic concatenation function that converts single-line segments to closed polygon objects (see Fig. 6). This is a very useful feature in urban noise mapping where AutoCAD files of buildings and roads are available, but are often built up in a way that is optimised for drawing and bears little or no resemblance to the physical objects represented
- There are several methods of assigning heights to objects and automatic fitting of line and area objects to the ground surface, reducing modelling time for roads in undulating terrain
- A routine to simplify polygonal objects with regard to their neighbourhood – particularly useful for smoothing height contours to a suitable resolution for noise calculations

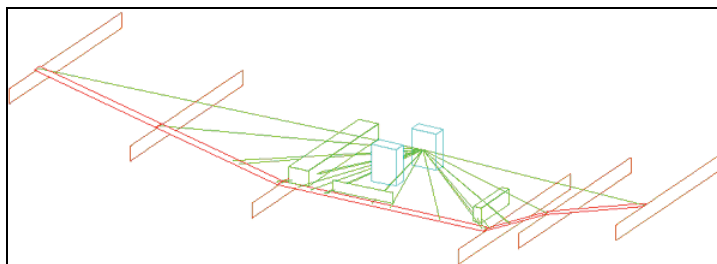
- Automatic terrain reshaping can be done, for example, along the given axis of a planned road or next to a new industrial site
- A Model Checking function – useful for automatically checking and correcting area polygons and closing gaps in polylines

Calculation

All Lima packages calculate in accordance with a wide range of international and national standards and regulations including the European Commission's de facto methods for mapping road (French NMPB/XPS 31-133), railway (Dutch RMR/SRM II) and industrial noise (ISO 9613) including optional modifications in accordance with the END and Interim Methods. The Lima Advanced package also includes ECAC Doc. 29, the European Commission's de facto method for mapping aircraft noise. A Lima Aircraft Module is also available for calculating in accordance with the ECAC Doc. 29 German AzB, AzB-L, LBF and DIN 45684, and for the simulation of a moving point source.

The determination of the sound-propagation path is based on the demands of the applied method and on rigorous analysis to ensure good and proper results. Line segmentation is performed by the 'projection method' (see Fig. 7) while analysis of path deviation for screening due to obstacles uses 'rubber-band logic' unless demanded differently by the specific regulation. Side deviation is determined by a worst-case analysis based on rotating the plane of propagation. Calculation of reflection is based on virtual sources and barriers and reflectors can be positioned behind other barriers or reflectors. Results can be calculated for several periods, for example, a week, a weekend, the daytime, or a specific hour of the night. Compound parameters such as L_{DEN} can also be calculated. Results are available as overall levels or, where the method requires, in octave bands. The emission attributes that will lead to the L_{DEN} can be customised to cope with even complex definitions, such as, when the defined rest period is separated into morning, noon and evening. Time periods for meteorological data may be independent.

Fig. 7
Line source
segmentation using the
projection

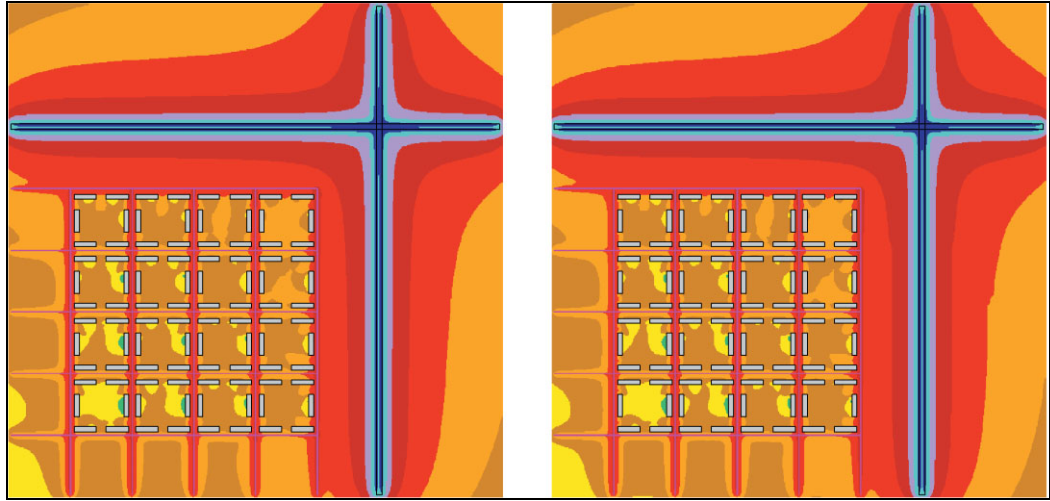


Indoor sources can also affect outdoor noise levels. Lima handles them as façade sources whose emission is determined by source attributes and building wall attenuation.

For each calculation, objects can be assigned one or more relevant calculation models. In addition, sources can be grouped to provide information on group contributions at receiver points as an aid to noise reduction and management.

Accuracy and calculation speed are inversely linked, that is, the higher the accuracy required, the longer the calculation will take for a given number of receiver points. However, Lima offers the user options for optimising calculation speed and accuracy as he/she sees fit. A fetching radius can be separately defined for both sources and reflectors to avoid calculating the contributions from these objects at distances further away. Careful selection of fetching radii has little effect on result accuracy. This has the added advantage of reducing the amount of result data enabling speedier analysis. In addition, a user-defined maximum tolerance in results enables Lima to neglect insignificant sources. Lima can also simplify terrain models and buildings to speed up calculation times. In addition, the achieved result quality can be statistically analysed by comparing results with a few, high-quality recalculations at random grid positions.

Fig. 8
 Calculation speed can be greatly optimised with negligible loss of accuracy. The calculation on the left was set to a deviation of 0 dB and took 609 seconds for a 40 000-point grid. The calculation on the right on the same grid was set to a deviation of 1 dB and took 110 seconds. Times are given for a 400 MHz PC



Results are available in various degrees of detail. They support comprehensive overviews as well as detailed results, which will even document the virtual source position and details of the entire propagation path for each sound path including reflections (see Fig. 9). The grid result files in ASCII format allow verification. Horizontal grids can have a constant height, either absolute or relative to the ground. Vertical grids can be in any plane or on a façade. Results can be easily exported to Microsoft® Excel or Word.

Fig. 9 Result table outputs showing different degrees of detail

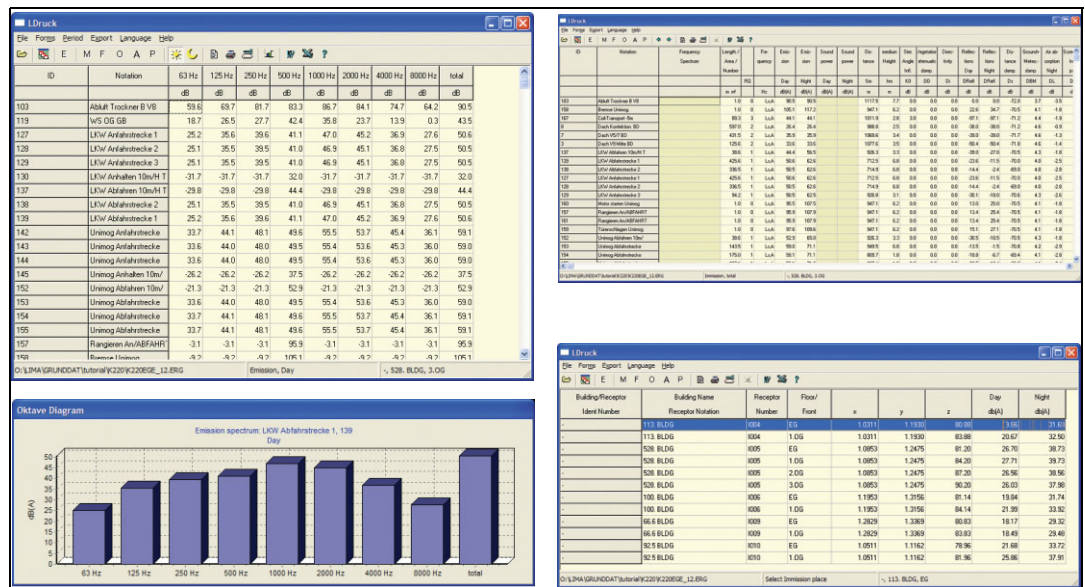
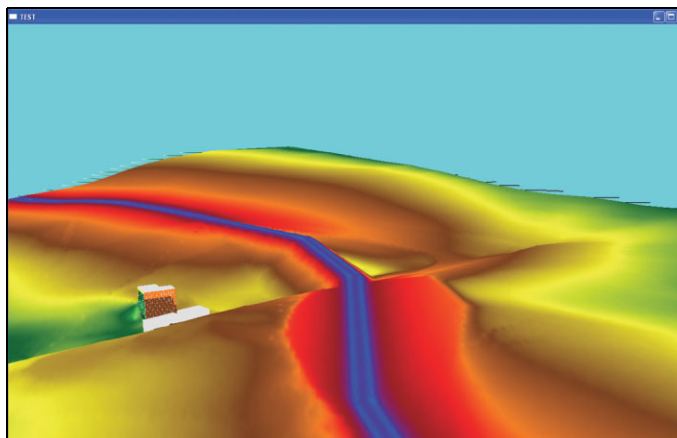


Fig. 10
 3D result presentation including façade levels



A single calculation can cope with over a million edges of terrain, buildings and emitters and up to almost 1 billion grid points, depending on the Lima package. For these and larger models, the limitation is based on the size and power of the computer or server used.

Fig. 11
Tiling allows automatic
and improved
calculations of large
areas



This means that much larger areas must be tiled into smaller areas. However, sources and obstacles outside each calculated tile must be included to prevent inaccurate results at the edges of the tiles. In order to cope with this problem, Lima automatically and correctly tiles large models, thus reducing the risk of user error and ensuring the quality of results throughout the area. If increased calculation speed of large and very large models is required, additional optional calculation clients can be added to other workstations. Results of all tiles can be post-processed as graphics, or combined (superpositioned).

Harmonoise

Lima supports calculation according to the ‘Harmonoise method’, based on the ‘Point to Point’ calculation DLL, submitted by the Harmonoise Working Group.

Analysis

Several post-processing features are available in Lima:

- The Estimate Emission function uses measurement results at various positions to estimate the emission of several unknown sources. To further ease this task, Lima can import data from the 2260 Investigator™ sound level meter and from the Type 2250 Hand-held Analyzer
- The Noise Abatement function provides a prioritised list of sources that contribute to the level at a particular receiver position. Maps showing the influence of line sources at receiver points at fixed distances to the source can also be produced
- The Uncertainty function calculates the overall uncertainty of results based on average of uncertainties of input parameters (source & model data, calculation algorithms and software settings)

The **Lima Plus** package includes several extra analysis modules:

- Superposition can import several grid results into larger grid-result files and generate the best- and worst-case grid. Result files and constants can be added and subtracted arithmetically or logarithmically. This enables, for example, combined noise maps of adjusted L_{DEN} (where aircraft noise is penalised and railway noise is given a railway bonus) that can be used to represent overall community reaction to the ambient noise. Additionally, existing grid data can be used to generate new grids by interpolation and transformation
- Statistics enables an analysis of the average and standard deviation of results or of the differences between results. This helps in assessing the quality of the model
- The Exposure Map function relates the number of inhabitants to calculated noise levels at one or more heights on façades. Several algorithms can be supported
- Conflict maps can be produced to show areas where acceptable noise levels are exceeded. This is useful for assessing different planning zones, each with their own limits
- The Optimising Barriers function optimises the heights of barriers to achieve noise limits at defined receiver points by minimising the total screen area. Barriers are categorised into groups with limitations on the permissible changes in height. Interaction between barrier elements is taken into account

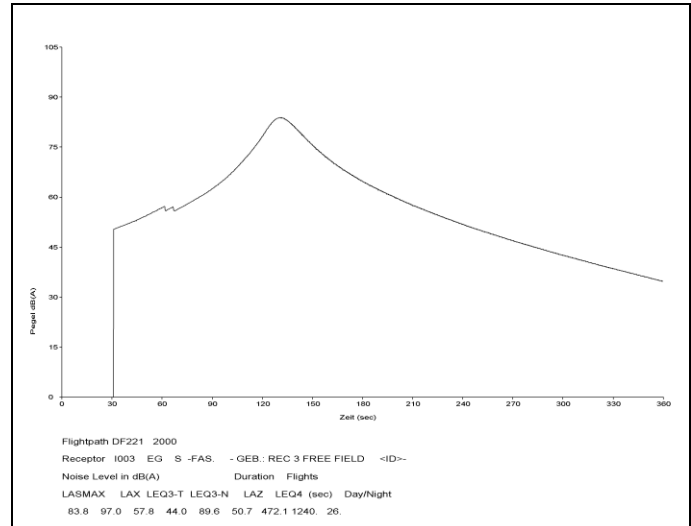
- New functionality is also added to the Noise Abatement module so that Lima can do best-/worst-case analyses for sources at varying positions on a given line. This can be used to help determine where to position noise barriers
- Soundscaping: Lima can mix source-specific noise levels at selected receiver points with either actual or nominal sound recordings of the source. The resulting sound recording can be replayed in Lima or exported for mixing with other source levels for subsequent soundscape analysis (for example, to assist in public enquiries or for urban soundscape design)

Fig. 12

Analysis of the noise from a moving point source at a receiver point in the Lima Advanced package

The **Lima Advanced** package includes all the above analysis modules and the following additional functions:

- The Fixing Quotas function optimises the noise emissions of groups of sources so that limits at defined receiver points are not exceeded and the total emission is maximised within user-defined limits for particular areas of sources. This helps in planning the use of new industrial sites close to noise-sensitive locations
- More functionality is added to the Noise Abatement module so that a moving point source can be simulated. This produces a graph of the noise level at a receiver over time as well as determining the L_{Max} , SEL, etc. of the pass-by event

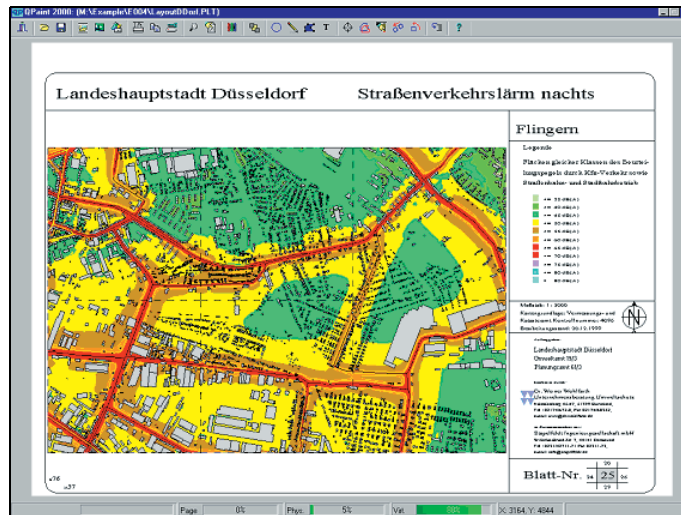


Furthermore, as model and result data are organised in configurable tables, these can be exported to other software such as Microsoft[®] Excel or GIS software for additional analysis.

Reporting

For all Lima packages, powerful graphical output and reports can be produced in HPGL or Adobe® PostScript®. There are user-defined layouts and legends for plots, scalable to various sizes of printer or plotter paper. Result plots can contain noise maps, model data, background bitmaps and user-defined logos. Model and result data appear in configurable tables that can be printed and exported to Microsoft® Word and Excel to produce different report formats. Lima Plus and Lima Advanced can also plot 3D, hidden-line vector views.

Fig. 13
Sample printout from
Lima

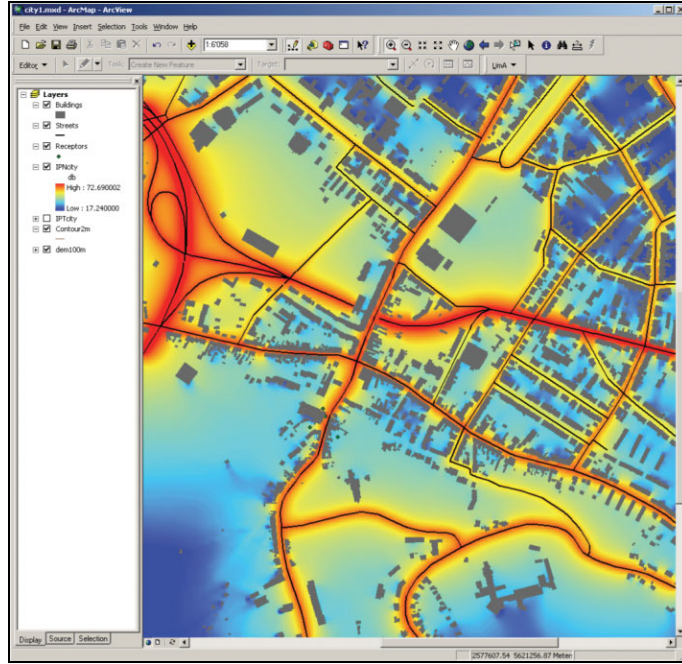


Applications

Lima can be used in a wide range of applications where noise calculation is required. For example, with its tiling and data exchange functions, Lima is well-suited to national and urban noise mapping for fulfilment of the European Commission's Assessment and Management of Environmental Noise Directive 2002/49/EC. It complies with the defacto interim methods defined in the Guidelines on Revised Interim Computation Methods 2003/613/EC. In addition, Lima tools support and extend the advice in the European Commission's Assessment of Exposure to Noise Working Group's Good Practice Guide. Its ability to determine source levels from measurements and identify sources with bitmaps aids environmental noise management as required, for example, by the European Commission IPPC Directive (96/61/EEC). All Lima packages are suited to environmental noise-impact assessments whether it be the standard package, capable in itself of dealing with complex situations, or the advanced package with its Fixing Quotas function.

The modular design of Lima and its ASCII data exchange supports easy integration into other software packages. Thus, Lima calculation modules can be integrated into environmental management, traffic management and GIS as the noise-calculation core.

Fig. 14
Lima can be integrated seamlessly into ArcGIS using LimaArc



Lima is already used in connection with GIS tools such as ArcView/ArcGIS/ArcInfo (see Fig. 14) so that noise calculations can be made with the power of Lima using your familiar GIS user interface. Lima also supports the use of further environmental analysis tools, based on the Lima input model in, for example, the calculation of air pollution and solar radiation.

Applications and Products

Lima is available in three packages to match various applications and budgets:

- **Lima 7812 A:** Designed for small consultants and as an entry-level product to the world of Lima and environmental noise calculation, this can calculate models of up to 20000 obstacle edges and 4000 emitters. Tiling is not supported. It includes all standard functions and covers all the specified road, rail and industry methods. Data can be imported and exported in DXF format
- **Lima Plus 7812 B:** Designed for medium-scale local authorities and industries, this can calculate models of up to 60000 artificial obstacle edges, 180000 terrain objects, such as contours and slope edges and 12000 emitters without tiling. It includes interactive 3D graphics, superposition, statistics, annoyance analysis, noise exposure and conflict maps, soundscaping, barrier optimisation and best-/worst-case analysis, and data exchange in DXF and SHP formats, in addition to all the functionality of the standard Lima package
- **Lima Advanced 7812 C:** Designed for the noise mapping and management of large cities and regions, this can calculate models of over 100000 obstacle edges and 200000 emitters without tiling, requiring approx., 200 MB RAM PC. It includes ECAC Doc. 29, fixing emission quotas and moving-point analysis, in addition to all the functionality of the Lima Plus package. It can be configured as a larger version, depending on the customer's hardware

In addition, three further modules are available for all the above packages:

- **Lima Aircraft Module BZ 5441:** Enables calculation of aircraft noise in accordance with ECAC Doc. 29 and the German AzB method, and allows simulation of a moving point source
- **Lima Data Exchange BZ 5442:** Enables import and export of data in all defined data-exchange formats (see specifications)
- **Lima Advanced Calculation Client License Pack BZ 5553:** Enables Lima Advanced calculation licenses on two other workstations, within the same network environment as the main Lima package, for increased calculation speed of large and very large models

Lima is also available in other configurations to fit a particular user's needs. Contact your local Brüel & Kjær representative for more information.

Support and Services

The first year's subscription to Brüel & Kjær's Lima Software Support and Maintenance Agreement is included in all packages. This is a service offered by Brüel & Kjær. With a valid Lima Software Support and Maintenance Agreement, you get all Lima patches and upgrades within the subscription period, ensuring that you have the latest and best-supported tools. It is also your security for getting quick and professional help when you need it, saving time and money. If you ever have a software problem with Lima, the agreement entitles you to help by e-mail, fax and telephone. Brüel & Kjær will respond to your Lima problem no more than 2 working days¹ after we have received your request.

In addition, Brüel & Kjær offers both product (Lima) and application (calculation and mapping) training courses. Courses are held at the Brüel & Kjær University at the corporate headquarters, at national training facilities or on-site at a customer location. Lima training courses enable you to get the most out of your Lima software. Application training courses are not product-specific and give you an insight into calculation software and applications in general, thus improving your use and understanding of them. See www.bksv.com for more information about training courses.

1. All working days from 09.00 – 17.00 Central European Time (Closed at weekends and Danish Public Holidays)
America: + time difference to CET
Far East and Asia: + time difference to CET

Specifications – Type 7812

Server Concept

Supports multiple-processor systems and networks

Graphic User Interface

Menus and Dialog: All input supported by on-line Help, default input user-defined, last input saved per project, input dialog to set up job files for external software recorded, automatic file management for tiling, user-defined toolbar functions

Command Line: May use variables, can be organised in macros and nested macros, allows nested search loops, search commands may combine attribute and geometry relations

On-line Help: Available for all dialogs

Geometry Handling

Geometry queries and manipulation, automatic geometry checks, correction/indication of corrupt objects, marking double objects, automatic partial/arithmetic change of attributes

Geometry Manipulation: Includes move point/object, rotate, stretch, insert/delete vertex, determine starting vertex, copy/split object, create parallel, select/clip objects by polygon area, change object type, copy/substitute as parallel object, combining buildings to larger objects

Display Information

Text, user-defined symbols of object attributes, attribute-defined display style (screen and plots)

3D Views (Lima Plus 7812 B and Lima Advanced 7812 C only): Hidden-line vector display/plot, OpenGL display

Model Checking

Automatic checking/correction of area polygons, automatic gap-closing in polylines

Model Elements

Attributes: <200 per object, editable in user-definable tables

Z Definition: Absolute or relative to terrain, buildings, bridges, embankments

EMITTERS

Types: Road, rail, industry, aircraft, leisure, sports

Geometry: Point, line, area, vertical areas (façade – façades can be nested)

Multiple Time-definition: Per object

Directivity: 3D, 10 degree resolution (horizontal and vertical), symmetrical around orientation, user-defined in 0.1 degree steps

Emission Studies: Sports, parking, lorry loading, forklift truck usage, petrol-filling stations included

Other Main Attributes: Impulse correction, Tone Correction, linked sound files and bitmaps

OBSTACLES

Types: Screen, building, embankment, embankment with screen, bridge, cantilever roof, attenuation areas, residences

Reflection Factor: Separate for side of obstacle, underside of roof

GROUND

Definition: Single point, contour lines, (triangular) ridges and fracture edges, gradient relation between slope edges, height grid data

Contour Lines: Can be generated from the ground model, act as barriers for propagation

OTHER

Meteorological Areas: Separate meteorological data per period (ISO 9613 C₀ and XPS 31-133 “% downwind”), interpolate data of a net of meteorological stations, defined in the model

Planning Zones: Noise limits, population

Data and Model Entry

Data Input: Digitiser, mouse, keyboard, import

Bitmaps: Multiple, calibrated, clipped and rotated used as background

Display: Opaque, transparent, resolution-reduction option

Import¹: Tabular data, DXF, SHP, ArcGIS, ArcView, ArcInfo, Atlas-GIS, ESZI, GeoMedia, GRANIS, MapInfo®, MOSS, SICAD SD, SICAD SQD, SoundPlan® (ASCII), VISUM®, measurement data from Type 2260 and Type 2250, wind statistics (WKL), INM result files, TNM result files, XML, OS MasterMap®

Export¹: Tabular data, DXF, SHP, ArcGIS, ArcView, ArcInfo, MapInfo, TNM (FHWA)

Object Linking: Tables, DBF, Microsoft® Access

Databases: 1/3-octave bands, reflection and transmission properties, directivity

PRE-PROCESSING

Concatenation: Single-line segments to closed polygon objects

Object Height Assignment: Several methods

Automatic fitting of line and area objects to ground surface, simplification of polygon objects with regard to neighbourhood

Objects/Attributes: Inherit attribute information from matching geometry, user-defined configuration including on-line Help and default input values

Calculation

REGULATIONS

- **General:** ISO 9613-2, Harmonoise, MSZ 15036
- **Road:** RLS 90, DIN 18005, RVS 3.02, NMPB/XPS 31-133, CRTN (L₁₀ and L_{Aeq}), UT2.1-302
- **Industry:** VDI 2714/2720/2571, DIN 18005, DIN 18005, ÖAL 28, BS 5228, DAL 32
- **Rail:** SCHALL 03, DIN 18005, AKUSTIK 04, TRANSPAPID, ÖAL 30 (ÖNORM S 5011), CRN, RMR/SRM II, RLM2/ISO, MSZ 2904
- **Aircraft:** ECAC 29, AzB, AzB-L, DIN 45684, LBF, simulation of moving point source

Frequency: Average frequency, octave and 1/3-octave band (depending on method and option)

Geometry:

- Sound Propagation Path: According to method
- Line Segmentation: Projection method and depending on regulation
- Path Deviation: Rubber-band logic and depending on regulation
- Side Deviation: Worst case analysis based on rotating the plane of propagation (rubber-band logic only)
- Reflection: Virtual sources and barriers, reflectors may be behind other barriers/reflectors unless demanded differently by regulation

Periods: Week, hour, reference period including L_{eq24} and Day, Evening, Night in user-defined sub-periods, compound period including L_{DEN}

Sources:

- Indoor sources: Façade sources, emission corrected by building-wall and roof attenuation
- Groups: Determine calculation method, result grouping
- Multiple Emissions: ≤24 emissions per object calculated in parallel in one run

Accuracy: User-defined by:

- Fetching Radius: For emitters and reflectors
- Tolerance: Maximum acceptable deviation against “accurate” calculation
- Simplification: Ground and buildings
- Grid interpolation

Statistical Analysis of Result Quality: Comparison of results with high-quality recalculation at random positions

1. The following formats are only available with Lima Plus 7812B and Lima Advanced 7812C: DXF and SHP (ArcGIS, ArcView, ArcInfo)

Capacity: Handling of objects (terrain, buildings and emitters) calculated in tiles

- Max. Grid Points in Tile: 32000 × 32000
- Max. Obstacle edges/Emitters in Tile:
 - Lima Type 7812A: 20000, 4000 emitters
 - Lima Plus Type 7812B: 60000 (plus 180000 terrain objects), 12000 emitters
 - Lima Advanced Type 7812C: >1000000, 200000 emitters (approx. 200 MB RAM)
 - Tiling Process: Automatic

Results

Single Receptor: Several heights per position, parallel to façades, parallel to roads in various degrees of detail, propagation path per reflection description option

Grid Receiver:

- Heights: Constant above ground, constant above topography, absolute
- Vertical: Vertical grid, on façades
- Grid result format: ASCII

Vertical & Horizontal Grids: In parallel on same model

3D Visualisation and Modelling: Interactive 3D visualisation, 3D hidden line vector graphics

Post-processing

Model and Result Data: Configurable tables for post-processing in external software

Superposition¹: Grid results imported into other grid results, best-/worst-case result, add/subtract results or constants arithmetically or energetically, skip results at max./min. levels, result rounding, generation of new grids by interpolation and transformation, adjustment of grid values to determine façade levels by -3 dB in accordance with WG-AEN Good Practice Guide (2003), statistics

Statistics¹: Average and standard deviation of results or result differences

Conflict Map¹: Shows exceedance of noise limits in planning zones

Noise Exposure¹: Relates number of inhabitants to results at one or more heights by façades. Based on “most exposed façade”, one or all façade receiver points of a “residence” with 7 noise-exposure algorithms based on reference and compound periods including L_{DEN} , map 2D tabular outputs showing the distribution of inhabitants in buildings within classes of maximum vs. minimum/average façade levels

Fixing Quotas²: Optimises noise emissions of source groups within limits at receiver points

Estimate Emission: Estimates source emission from SPL measurements, import from Microsoft[®] Excel and 2260 Investigator sound-level meter

Noise Abatement:

Priority list, map of influence of line sources

Best-/worst-case analysis for variable source position on a line¹

Soundscaping¹: Playback of source sound recordings adjusted by attenuation from source to user-defined receiver position, export as WAV file

1. Lima Plus 7812B and Lima Advanced 7812C only

2. Lima Advanced 7812C only

Moving Point Source Simulation³: noise level vs. time, L_{Max} , SEL, etc., at receiver

Optimising Barriers¹: Optimises barrier heights to achieve noise limits at receiver points by minimising barrier area, barrier groups with max. height-change limits

Uncertainty: Calculates overall result uncertainty at selected receiver points from input parameter uncertainties

Printing and Export

Printing:

- Graphics: User-defined layout and legends, scalable to DIN- size paper
- Results: Noise map, model data, background bitmaps, logo

Export: Model and result data organised in configurable tables to Microsoft[®] Word, Microsoft[®] Excel, GIS, etc., model and result data in DXF and GIS formats (depending on package)

Quality Assurance Standard Compliance

Nordtest Method “Framework for the Verification of Environmental Noise Calculation Software” ACOU 107 (2001)

Draft German DIN 45687 quality criteria for acoustic calculation software

Hardware and Software Requirements

Hardware: SVGA graphics display (1024 × 768, small character)

Processor: Intel[®] or compatible

Mouse: Microsoft[®] or compatible

Operating Systems: Microsoft[®] Windows[®] 9x, Windows NT[®] 4.0, Windows[®] 2000, Windows[®] XP

Recommended Specifications for Running Lima

Minimum PC Specification: 486 133 MHz, 32 MB RAM, 500 MB HDD

Microsoft[®] Windows[®] 95, 2 MB Video Ram

Recommended PC Specification: Pentium[®] IV 3 GHz, 256 MB RAM, 20 GB HDD, Microsoft[®] Windows[®] 2000 or Windows XP[®], 16 MB Video Ram

Recommended Specifications for Running Lima Plus

Minimum PC Specification: Pentium II 200 MHz, 64 MB RAM, 6 GB HDD, Microsoft[®] Windows[®] 95, 4 MB Video Ram

Recommended PC Specification: Pentium IV 3 GHz, 512 MB RAM, 60 GB HDD, Windows[®] 2000 or Windows XP[®], 16 MB Video Ram

Recommended Specifications for Running Lima Advanced

Minimum PC Specification: Pentium III 550 MHz, 128 MB RAM, 10 GB HDD, Microsoft[®] Windows[®] 95, 4 MB Video Ram

Recommended PC Specification: Pentium IV 3 GHz or faster (Lima is dual processor compatible with suitable OS), 1 GB RAM per processor, 60 GB HDD, Microsoft[®] 2000 or Windows XP[®], 16 MB Video Ram

3. Lima Advanced 7812C and Lima Aircraft Module BZ5441 only

Ordering Information

Lima is available in three packages and three modules:

Lima Type 7812 A:

Calculates models of ≤ 20000 obstacle edges, 60000 terrain contour edges and 4000 emitters without tiling. Covers all specified road, rail and industry methods. Data can be imported and exported in DXF format

Lima Plus Type 7812 B:

Calculates models of ≤ 60000 obstacle edges, 180000 terrain contour edges and 12000 emitters without tiling. Includes interactive 3D graphics, superposition, statistics, annoyance analysis, noise exposure and conflict maps, soundscaping, barrier optimisation and best-/worst-case analysis, DXF and SHP data exchange, all functions of the Lima Type 7812 A package

Lima Advanced Type 7812 C:

Calculates models of ≥ 1000000 obstacle or terrain edges and 200,000 emitters without tiling (200 MB RAM PC). Includes ECAC Doc. 29, fixing emission quotas and moving-point analysis, in addition to all the functionality of the Lima Plus 7812 B. Configurable to customer hardware

All Type 7812 Lima Version 5.0 Packages include the following accessories:

- Program on CD-ROM
- Program protection key
- License files on CD-ROM
- User Manual
- Lima Software Maintenance, Upgrade and Support Agreement for first 12 months after purchase

Lima Aircraft Module BZ 5441:

Calculation according to ECAC Doc. 29, German AzB, AzB-L, LBF and DIN 45684 simulation of moving-point source for all Lima packages

Lima Data Exchange Module BZ 5442:

Enables import and export of data in all defined data-exchange formats for all Lima packages (see specifications)

All Lima Version 5.0 Modules include the following accessories:

- Program on CD-ROM
- License files on CD-ROM
- Lima Software Maintenance, Upgrade and Support Agreement for first 12 months after purchase

Lima Advanced Calculation Client License Pack BZ 5553:

Lima Advanced calculation licenses for 2 workstations within the same network environment as the main Lima package

Includes the following accessories:

- Program on CD-ROM
- License files on CD-ROM
- Program protection keys (2)
- Lima Software Maintenance, Upgrade and Support Agreement for first 12 months after purchase

Lima is also available in other configurations – contact your local Brüel & Kjær representative for more information.

Accessories Available

2260 Investigator Sound Level Meter

2250 Hand-held Analyzer

Services Available

7812 A-MS1 Annual Lima Software Support and Maintenance Agreement

7812 B-MS1 Annual Lima Plus Software Support and Maintenance Agreement

7812 C-MS1 Annual Lima Advanced Software Support and Maintenance Agreement

7812 X-100 Upgrade to Lima Plus 7812 B from 7812 A

7812 X-200 Upgrade to Lima Advanced 7812 C from 7812 B

Lima training courses

Calculation and mapping training courses

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HEADQUARTERS: DK-2850 Nærum · Denmark · Telephone: +45 4580 0500 · Fax: +45 4580 1405
www.bksv.com · info@bksv.com

Australia (+61) 2 9889-8888 · Austria (+43) 1 865 74 00 · Brazil (+55) 11 5188-8166 · Canada (+1) 514 695-8225
China (+86) 10 680 29906 · Czech Republic (+420) 2 6702 1100 · Finland (+358) 9-521 300 · France (+33) 1 69 90 71 00
Germany (+49) 421 17 87 0 · Hong Kong (+852) 2548 7486 · Hungary (+36) 1 215 83 05 · Ireland (+353) 1 807 4083
Italy (+39) 0257 68061 · Japan (+81) 3 5715 1612 · Korea (+82) 2 3473 0605 · Netherlands (+31) 318 55 9290
Norway (+47) 66 77 11 55 · Poland (+48) 22 816 75 56 · Portugal (+351) 21 47 11 453 · Singapore (+65) 377 4512
Slovak Republic (+421) 25 443 0701 · Spain (+34) 91 659 0820 · Sweden (+46) 8 449 8600
Switzerland (+41) 44 880 7035 · Taiwan (+886) 2 2502 7255 · United Kingdom (+44) 14 38 739 000
USA (+1) 800 332 2040 · Local representatives and service organisations worldwide

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